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MARKING GROUND TARGETS WITH RADIO TRANSMITTERS DROPPED FROM AIRCRAFT

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ABSTRACT.— Reports development and use of a radio transmitter device that can be dropped from aircraft into target areas in remote habitats. Such a device could be a valuable tool for studying and managing forests and wildlife, for controlling forest fires, and for handling emergencies.

KEY WORDS: Wildlife, forest fire control, telemetry, forest research and management, disease and insect detection.

A radio transmitter that can be dropped from an aircraft for locating pockets of diseased trees in remote areas has been needed for some time. Pockets of diseased trees are often easily seen from the air, but are sometimes difficult to find on the ground because of the characteristics of certain diseases, the density of trees and shrubs, the number of trees affected, and the lack of ground reference points. Locations have been marked by dropping toilet paper, plastic flagging, crepe paper, and aluminum foil, but none of these markers have been entirely satisfactory.

A radio transmitter, however, would enable forest managers to locate areas of diseased trees efficiently and quickly. It would expedite the harvesting of these trees before they are entirely dead and before the wood becomes unusable. Using such a method, forest managers could more easily mark areas and check them on the ground for research or survey purposes. Electronic markers have been successfully used in Canada to locate small forest fires (Ponto and Lynch 1973).

We carried out a study to develop and test radio transmitter packages that could be safely dropped from an aircraft into designated areas, and to find out how quickly those transmitters could be found on the ground. For successful use, the transmitter had to meet four criteria: (1) it would not injure anyone it hit, (2) it would be protected upon impact, (3) it would accurately fall into the target area, and (4) it would emit a signal that could be detected with receivers from a distance of at least 2 miles on the ground and at least 10 miles from the air.

MATERIALS AND METHODS

Tower Drops

Initial tests were made at the University of Minnesota radio-tracking facilities at the Cedar Creek Natural History Area, Bethel, Minnesota. Radio transmitters were placed in several devices, and each

device was dropped 12 times from a 100-foot tower. The following devices were tested:

a. Army transmitter with steel point (15 inches long, 70.0 ounces).
b. Plastic toy rocket (5 inches long, 0.35 ounce).
c. Foam rubber Nerf[1] ball (7-inch diameter, 2.5 ounces with a 36-inch plastic flagging tail).
d. Foam rubber Nerf ball (4-inch diameter, 0.5 ounce, with a 36-inch plastic flagging tail).
e. Sponge (6.5 inches long, 2 inches wide, 1.8 ounces).
f. Sponge-type football (5 inches long, 0.3 ounce).

Transmitters encapsulated in acrylic and weighing from 1.8 to 5.3 ounces were placed in the device. Each transmitter had a 12-inch antenna. Transmitter frequencies of 52.810 to 53.270 MHz and 150.700 to 151.275 MHz were used. An AVM[1] Model LA 12 receiver with a hand-held yagi antenna was used most of the time. Some tests were done with a receiver with a loop antenna (fig. 1).

Figure 1.—*Tuning radio receiver to transmitter frequency.*

Aircraft Drops

The 7-inch foam rubber Nerf ball was used in all air drops because it met our four criteria during initial testing and because its bright orange color made it highly visible. A slit was made in the ball and the transmitter was inserted into the center of the ball so that it was completely protected (fig. 2). Plastic flagging was attached to the ball at the slit that was then sewn closed with a heavy thread. Drops were made from single-engine aircraft at altitudes ranging from 100 to 1,200 feet. The aircraft either flew a straight approach or circled the target area at speeds ranging from 70 to 120 mph. Wind speeds ranged from 5 to 10 mph during drops. Twenty drops were made on 6 different dates into various habitats (table 1). Ground searches were conducted either the day of the drop, or 1 day or 5 days after. Distances from the nearest road to the transmitter ranged from 75 to 880 yards.

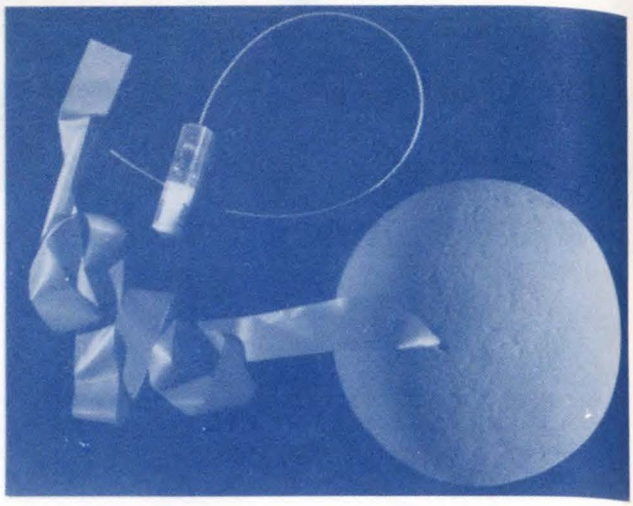

Figure 2.—*Nerf ball radio transmitter package.*

RESULTS

All transmitter packages were recovered undamaged after being dropped by aircraft into different habitats (table 1). All were found on the ground except one that was lodged in a tree. Search times ranged from 5 to 40 minutes after a signal was received. Distances from roads, brush density, and snow depth influenced the amount of search time needed. In seven drops, the transmitter package was either partially or entirely below the snow surface, leaving only the bright flagging exposed. This added visibility was important in decreasing the time that it took to locate and retrieve the marker.

Search crews were able to find target areas in all but two of the drops: in one, the small target area was missed; in the other, the transmitter landed in a creek and floated downstream, out of the target area. To hit target areas, the drops had to be properly timed in relation to airspeed. Accuracy from higher altitudes was achieved when drops were made from an aircraft circling the target area. Larger target areas were marked using the straight-line approach. On one drop, the tail of the transmitter device became entangled with the antenna, apparently causing greater drift.

[1]*Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

Table 1.—*Results of aircraft-dropped radio transmitters*

Drop no.	Date	Habitat and ground conditions	Aircraft altitude at drop	Aircraft Speed	Flight approach	Distance from ground target	Search time
			Feet	*m.p.h.*		*Yards*	*Min.*
1	6/13/73	Deciduous woods-shrubs	200	85-90	Straight	70	30
2	6/13/73	Open grassy field	200	85-90	Straight	0	20
3	6/13/73	Open grassy field	200	85-90	Straight	0	15
4	6/13/73	Deciduous woods-shrubs	200	85-90	Straight	50	40
5	8/30/73	White cedar swamp	500	100	Circling	50	5
6	8/30/73	White cedar swamp	500	100	Circling	75	40
7	8/30/73	White cedar swamp	500	100	Circling	65	22
8	8/30/73	White cedar swamp	500	100	Circling	55	7
9	4/9/74[1]	Deciduous woods	500	85-90	Circling	100	5
10	4/9/74[1]	Deciduous woods-snow	500	85-90	Circling	0	30
11	4/9/74[1]	Deciduous woods-snow	500	85-90	Circling	200	10
12	2/13/74	Bog-snow	600	70	Circling	300	9
13	2/13/74	Spruce aspen-snow	1200	80	Circling	100	25
14	2/13/74	Spruce-snow	700	80	Straight	440[2]	15
15	2/14/74	Jackpine-balsam-snow	200	80	Circling	100	20
16	2/14/74	Openfield snow	400	80	Circling	200	20
17	2/14/74	Light brush snow	100	100	Straight	10	15
18	7/5/79[3]	Deciduous woods-shrubs	1000	120	Circling	—[4]	15
19	7/5/79[3]	Deciduous woods-shrubs	1000	120	Straight	0	20
20	7/5/79[3]	Deciduous woods-water	1000	90	Circling	—[5]	10

[1]Search started 1 day after drop.
[2]Tail became tangled with antenna increasing drift.
[3]Search started 5 days after drop.
[4]Target area missed.
[5]Transmitter landed in creek, target area not found.

DISCUSSION AND CONCLUSIONS

Because of its safety and effectiveness, the foam rubber ball transmitter package is more suitable than previous marking devices. Although fixed-winged aircraft were used in this study, we believe that using this device with helicopters would permit even more accurate marking of ground locations.

This technique can have many uses: to quickly locate pockets of diseased and dying trees such as those infected by dwarf mistletoe, oak wilt, Dutch elm disease or insect outbreaks in remote, roadless areas; to mark fires that produce little smoke and are visible only from the air; to mark wolf-killed deer, wolf dens, large bird nests (e.g., goshawk, osprey, bald eagle), and other objects that are difficult to find from the ground; to speed recovery of lost or injured persons or to locate downed aircraft in remote areas.

LITERATURE CITED

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